801400805441 Kendinden Ayarlamalı Kontrol Sistemleri [1-5]

1. Kontrol sistemlerinin tanıtımı, Geri beslemeli kontrolörler, Matlab, Simulink sürekli zaman uygulamaları, transfer fonksiyonları [1-5]

References:

Kaynaklar

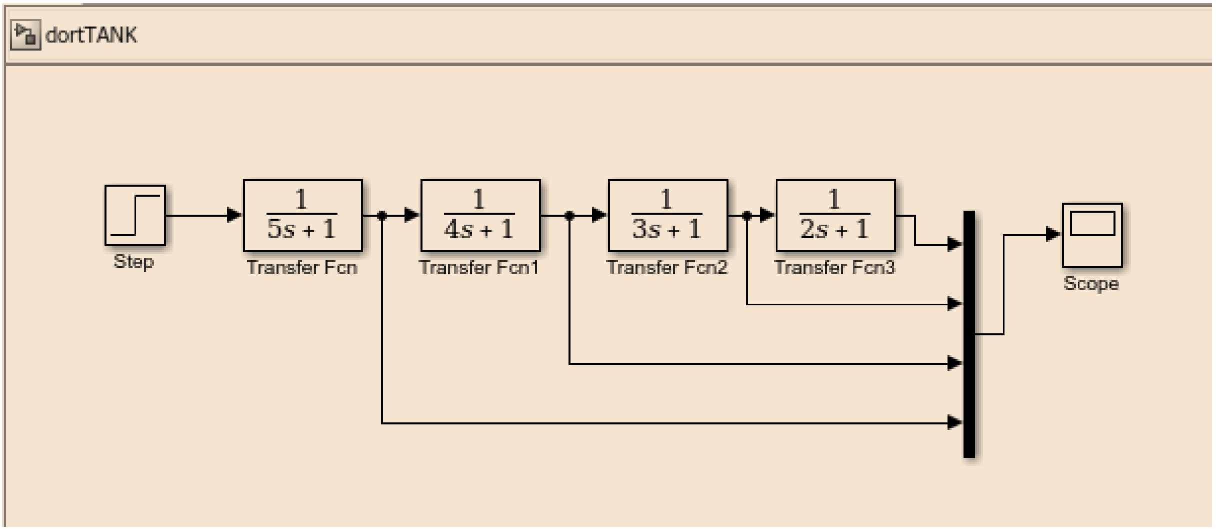
[1] Wellstead P. E., Zarrop M.B., 1991, Self-Tuning Systems, Control and Signal Processing, John-Wiley and Sons.

[2] Coughanowr D., LeBlanc S., 2009, Process Systems Analysis and Control, McGraw-Hill

[3] Bequette B.W., 2008, Process Control Modelling; Design and Simulation, Prentice-Hall

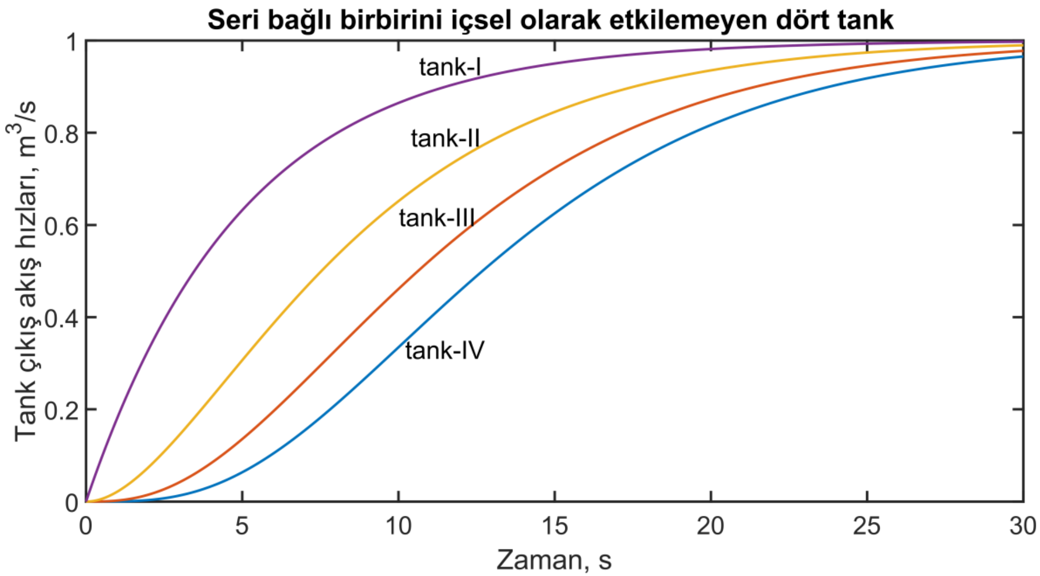
[4] Seborg D.E., Mellichamp D. A., Edgar T.F, Doyle F.J., 2011, Process Dynamics and Control , John Wiley and Sons

[5] Stephanopoulos G., 1984, Chemical Process Control : an introduction to theory and practice, Prentice-Hall

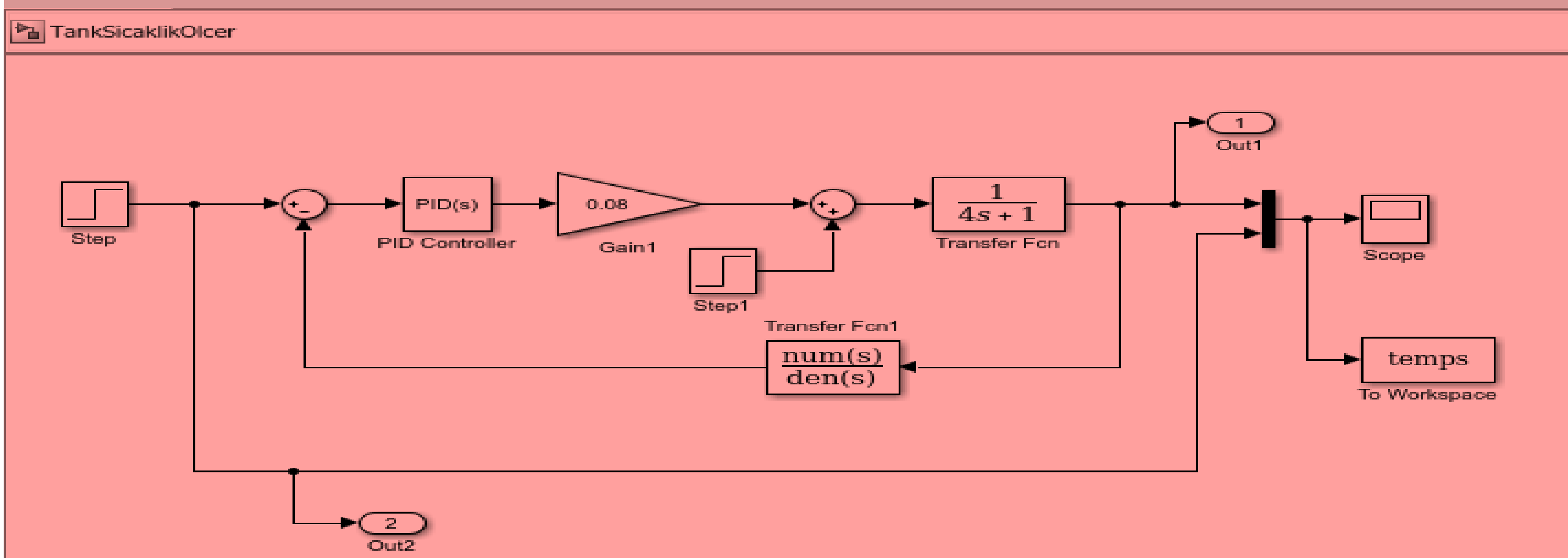


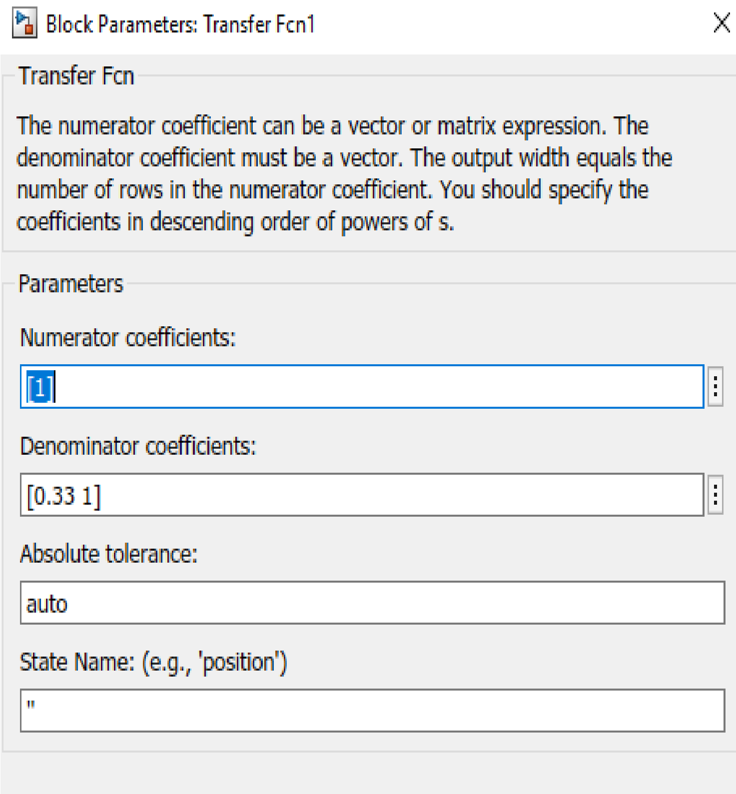
Birbirini içsel olarak etkilemeyen dört tank birbirine seri olarak bağlı birinci tank çıkış değişkeni birinci derece sistem cevabı veriyor. İkinci tank çıkış değişkeni ikinci derece sistem cevabı veriyor. Üçüncü ve dördüncü derece sistem cevapları sırası ile tank 3 ve 4 çıkışlarından elde ediliyor.

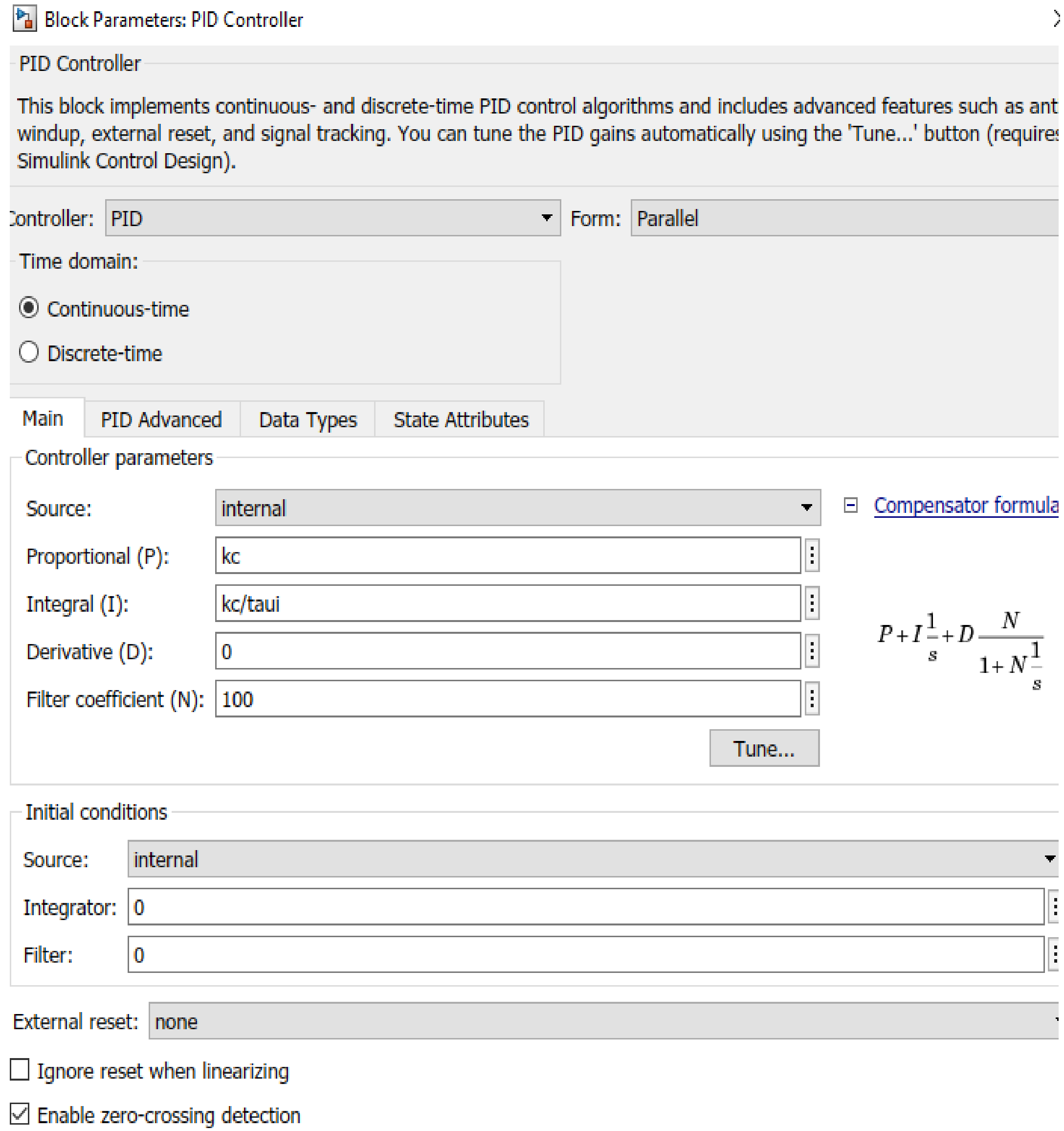
```
>> plot(ScopeData.time, ScopeData.signals.values)
>>
```



Su ısıtıcı sıcaklık ölçer ve kontrolör seri bağlı kapalı hat




Block Parameters: Transfer Fcn1
Transfer Fcn
The numerator coefficient can be a vector or matrix expression. The denominator coefficient must be a vector. The output width equals the number of rows in the numerator coefficient. You should specify the coefficients in descending order of powers of s.
Parameters
Numerator coefficients:
[1]
Denominator coefficients:
[0.33 1]
Absolute tolerance:
auto
State Name: (e.g., 'position')
''


Block Parameters: PID Controller
PID Controller
This block implements continuous- and discrete-time PID control algorithms and includes advanced features such as ant windup, external reset, and signal tracking. You can tune the PID gains automatically using the 'Tune...' button (require Simulink Control Design).
Controller: PID
Form: Parallel
Time domain:
Continuous-time
Discrete-time
Main
PID Advanced
Data Types
State Attributes
Controller parameters
Source: internal
Compensator formula
Proportional (P): kc
Integral (I): kc/taui
Derivative (D): 0
Filter coefficient (N): 100
$P+I\frac{1}{s}+D\frac{N}{1+N\frac{1}{s}}$
Tune...
Initial conditions
Source: internal
Integrator: 0
Filter: 0
External reset: none
Ignore reset when linearizing
Enable zero-crossing detection

Block Parameters: Step

Step

Output a step.

Parameters

Step time:

0

Initial value:

0

Final value:

0

Sample time:

0.001

☑ Interpret vector parameters as 1-D

☑ Enable zero-crossing detection

Block Parameters: Step1

Step

Output a step.

Parameters

Step time:

0

Initial value:

0

Final value:

5

Sample time:

0.001

☑ Interpret vector parameters as 1-D

☑ Enable zero-crossing detection

tanksicaklikPI_kc.m

```
clear all
clc
%PI kontrol tank ve sıcaklık ölçer seri bağlı
h(1,:)='g-';
h(2,:)='r-';
h(3,:)='b:';
h(4,:)='--';
h(5,:)='k-';
taui=2;
for i=1:4
    z=[5,10,20,100];
    kc=z(1,i);
    %the variable y in the 'sim' statement is taken from .......
    [t,x,y]=sim('TankSicaklikOlcer',50);
    plot(t,y(:,1),h(i,:))
    hold on
end
grid
hold off
```

PI kontrolör integral zamanı TI=2s sabit değerinde iken Kc dört farklı değer için kontrol edilen değişimi

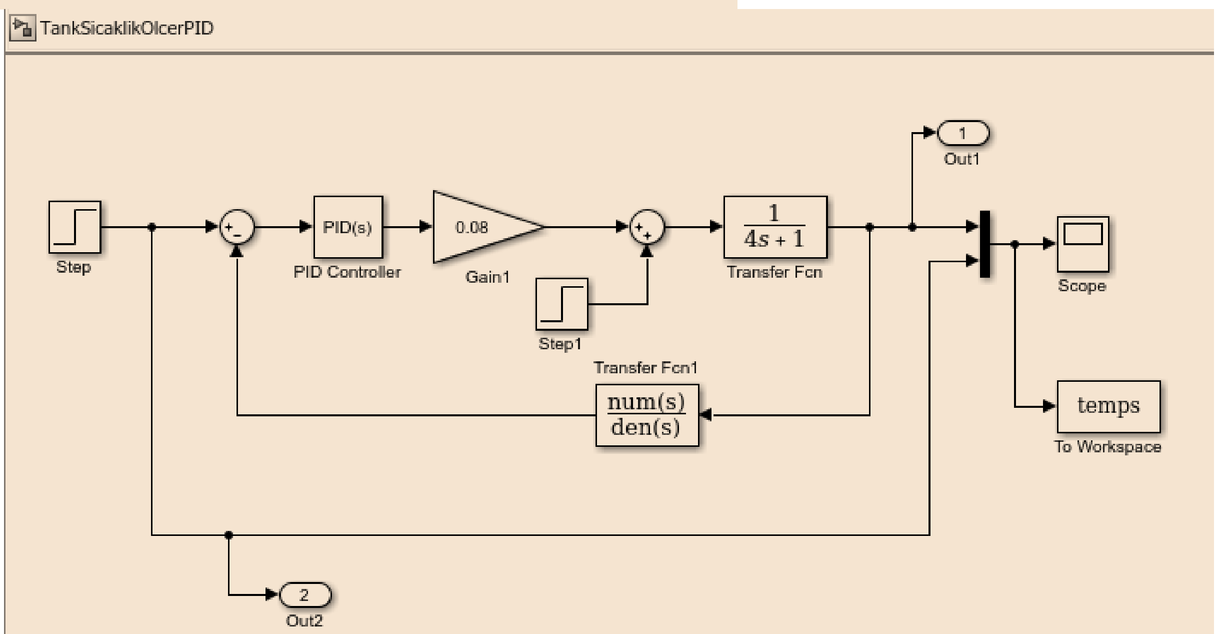
PID kontrolör integral zamanı TI=2s ve türev zamanı TD=10 s sabit değerlerinde iken türev ifadesi üzerindeki filtreleme farklı miktarlar (N=1000, 10, 0.1) kullanımında Kc dört farklı değer için kontrol edilen değişimi

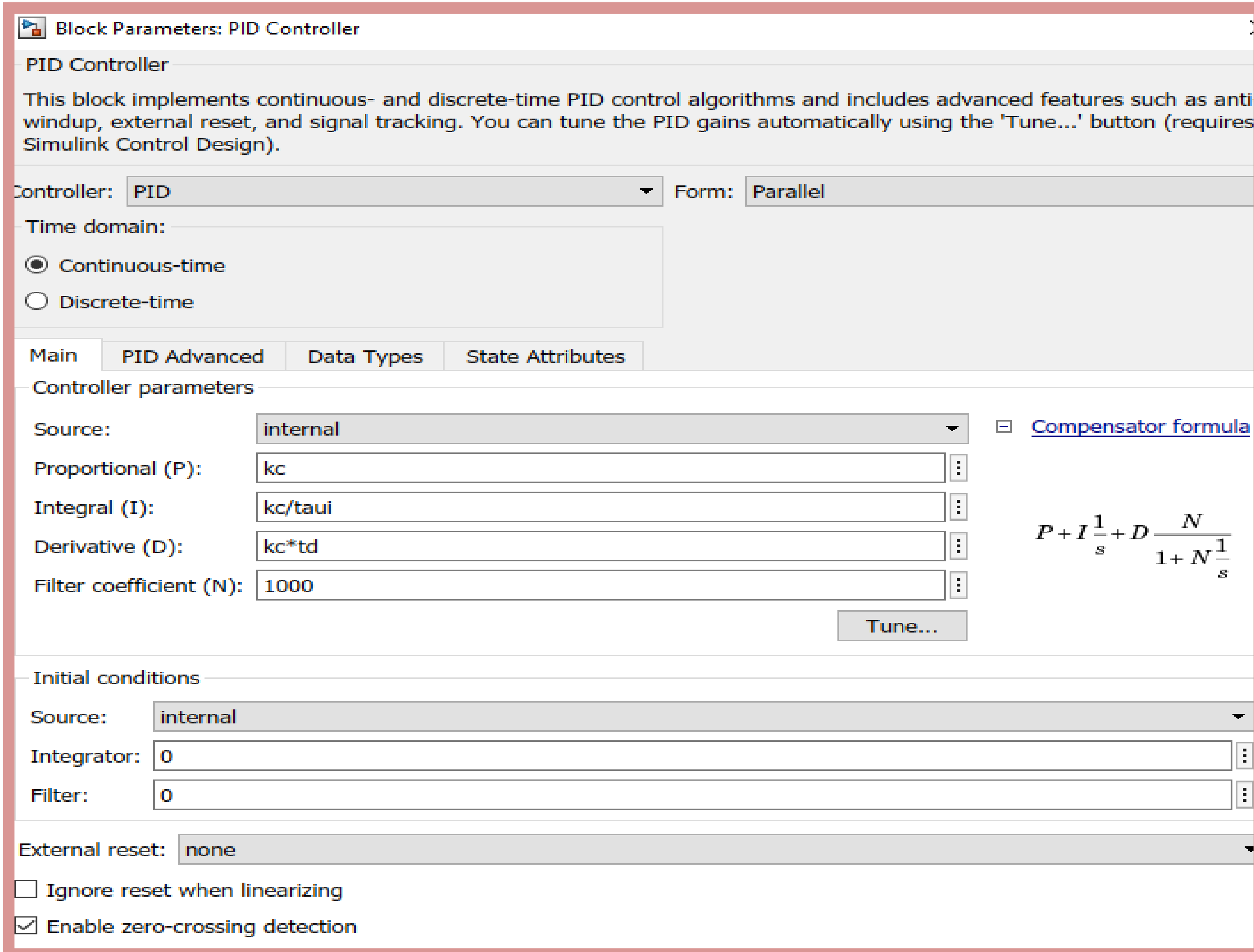
$$\boldsymbol{PID\ kontrol\ddot{o}r}:\ \boldsymbol{P + I\frac{1}{s} + D\frac{N}{1 + N\frac{1}{s}}}$$

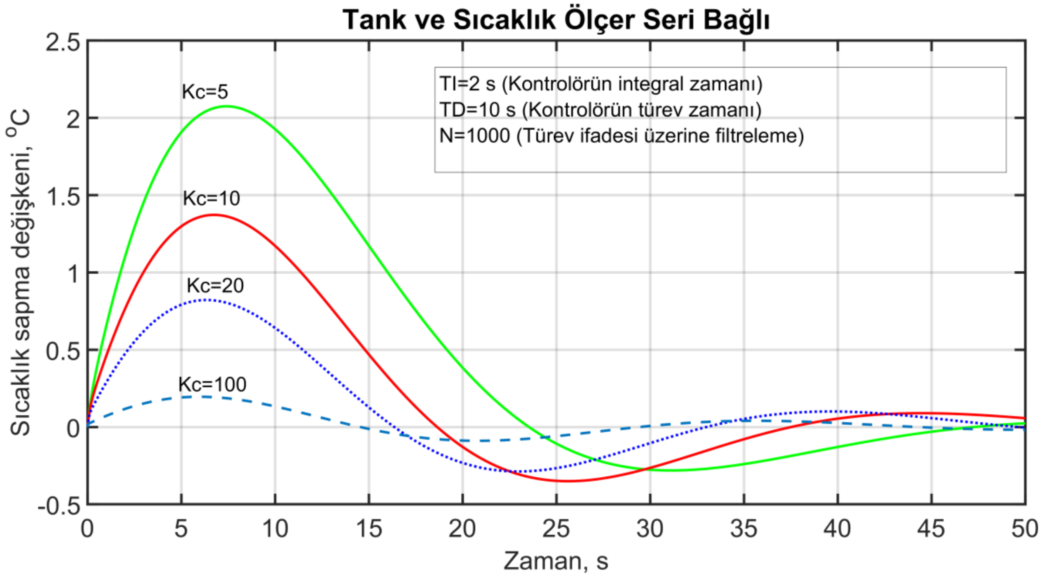
$$\boldsymbol{kontrol\ddot{o}r}:\ \boldsymbol{kc + (kc/taui)\frac{1}{s} + (kc * td)\frac{N}{1 + N\frac{1}{s}}}$$

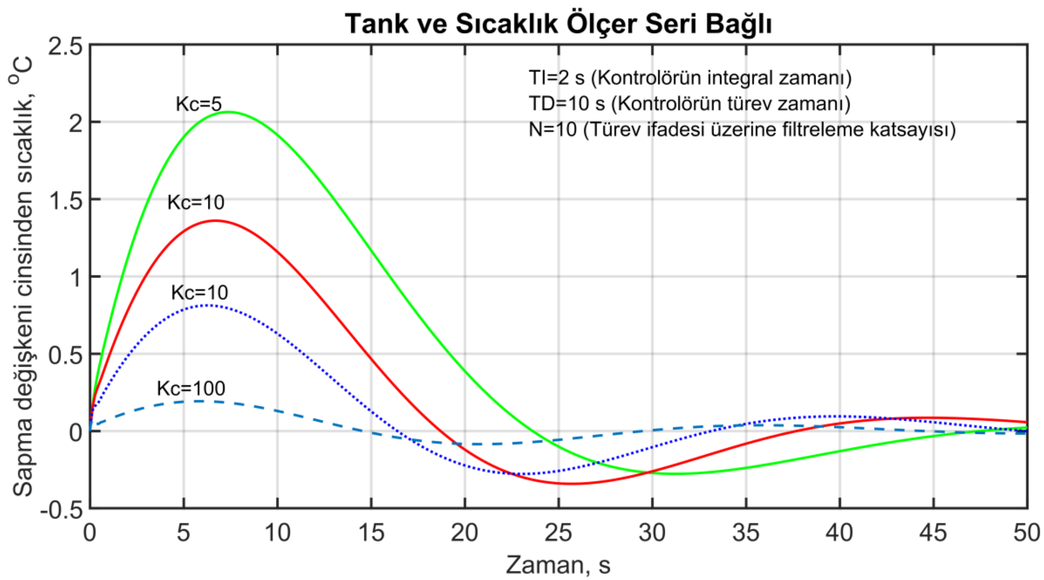
tanksicaklikPID_kc.m

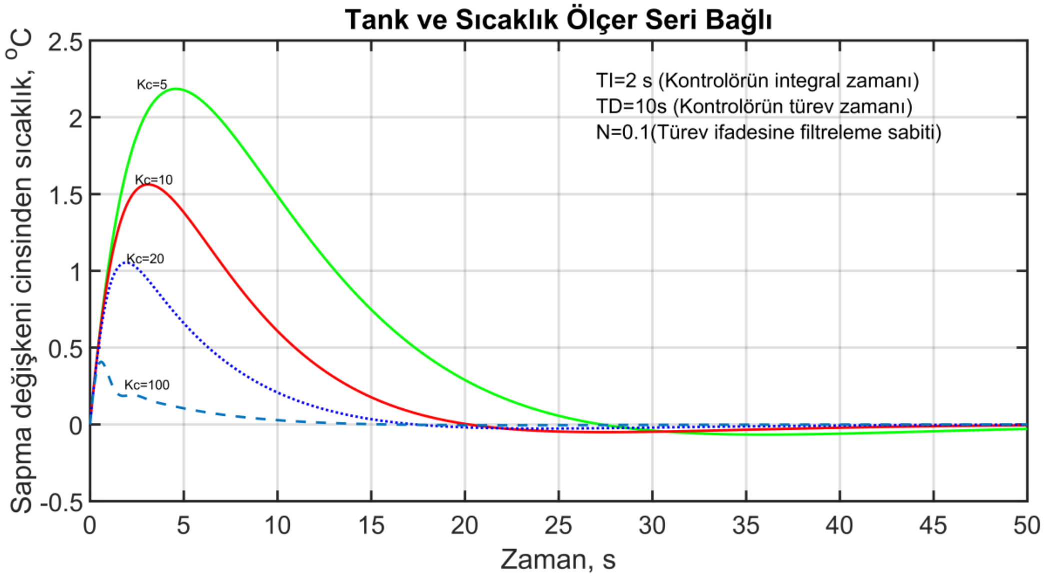
```
clear all
clc
%PI kontrol tank ve sıcaklık ölçer seri bağlı
h(1,:)='g-';
h(2,:)='r-';
h(3,:)='b:';
h(4,:)='--';
h(5,:)='k-';
taui=2;
td=10;
for i=1:4
    z=[5,10,20,100];
    kc=z(1,i);
    %the variable y in the 'sim' statement is taken from .......
    [t,x,y]=sim('TankSicaklikOlcerPID',50);
    plot(t,y(:,1),h(i,:))
    hold on
end
grid
hold off
```




Block Parameters: PID Controller
PID Controller
This block implements continuous- and discrete-time PID control algorithms and includes advanced features such as anti windup, external reset, and signal tracking. You can tune the PID gains automatically using the 'Tune...' button (requires Simulink Control Design).
Controller: PID
Form: Parallel
Time domain:
Continuous-time
Discrete-time
Main
PID Advanced
Data Types
State Attributes
Controller parameters
Source: internal
Proportional (P): kc
Integral (I): kc/taui
Derivative (D): kc*td
Filter coefficient (N): 1000
Tune...
Compensator formula
$P+I\frac{1}{s}+D\frac{N}{1+N\frac{1}{s}}$
Initial conditions
Source: internal
Integrator: 0
Filter: 0
External reset: none
Ignore reset when linearizing
Enable zero-crossing detection


Tank ve Sıcaklık Ölçer Seri Bağlı
TI=2 s (Kontrolörün integral zamanı)
TD=10 s (Kontrolörün türev zamanı)
N=1000 (Türev ifadesi üzerine filtreleme)
Kc=5
Kc=10
Kc=20
Kc=100
Sıcaklık sapma değişkeni, °C
Zaman, s
2.5
2
1.5
1
0.5
0
-0.5
0
5
10
15
20
25
30
35
40
45
50


Tank ve Sıcaklık Ölçer Seri Bağlı
TI=2 s (Kontrolörün integral zamanı)
TD=10 s (Kontrolörün türev zamanı)
N=10 (Türev ifadesi üzerine filtreleme katsayısı)
Kc=5
Kc=10
Kc=10
Kc=100
Sapma değişkeni cinsinden sıcaklık, °C
Zaman, s
2.5
2
1.5
1
0.5
0
-0.5
0
5
10
15
20
25
30
35
40
45
50



Sürekli zamanda uygulamalar:

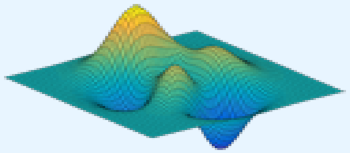
$$f = -12 + 15te^{-5t} + 25e^{-8t}$$

Laplace fonksiyonlarının tersini alarak sürekli zamanda fonksiyon elde edilmesi

$$Y(s) = \frac{15}{(s+5)^2} + \frac{25}{(s+8)} - \frac{12}{s}$$

Command Window

New to MATLAB? See resources for Getting Started.



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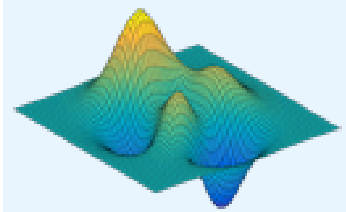
```
>> syms t s
>> f=-12+15*t*exp(-5*t)+25*exp(-8*t);
>> F=laplace(f,t,s)

F =

15/(s + 5)^2 + 25/(s + 8) - 12/s

>> simplify(F)

ans =

15/(s + 5)^2 + 25/(s + 8) - 12/s

>> pretty(F)
   15          25      12
-------- + ----- - --
       2    s + 8      s
(s + 5)

>> pretty(simplify(F))
   15          25      12
-------- + ----- - --
       2    s + 8      s
(s + 5)

>>
```

Command Window

New to MATLAB? See resources for Getting Started.



New MATLAB Graphics Syste

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```
>> syms s
>> ilaplace(15/(s+5)^2+25/(s+8)-12/s)

ans =

25*exp(-8*t) + 15*t*exp(-5*t) - 12

>> pretty(ans)
exp(-8 t) 25 + t exp(-5 t) 15 - 12

>>
```

Transfer fonksiyonları

```
>> d=[1 4];

>> b=[1 3];

>> c=[6];

>> c=conv(conv(d,b),c)

c =

    6    42    72
```

$$G(s) = \frac{6}{6(s+4)(s+3)} = \frac{6}{6s^2 + 42s + 72}$$

```
>> pay=6;
>> payda=[6 42 72];
>> sys=tf(pay,payda)

sys =

            6
  ------------------
  6 s^2 + 42 s + 72

Continuous-time transfer function.

>> pole(sys)

ans =

    -4
    -3
```

```
>> d=[1 5];

>> b=[1 6];

>> c=[1 7];

>> c=conv(conv(d,b),c)

        c =

            1    18   107   210
```

$$G(s) = \frac{8(s+3)}{(s+5)(s+6)(s+7)} = \frac{8(s+3)}{s^3 + 18s^2 + 107s + 210}$$

Gain=8

Zero=-3

Kutuplar üç adet= -5, -6, -7

Command Window

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many new features. Some existing cc
Learn more

```
>> sys=zpk([-3],[-5 -6 -7], 8)

sys =

       8 (s+3)
  -----------------
  (s+5) (s+6) (s+7)

Continuous-time zero/pole/gain model.

>> 
```

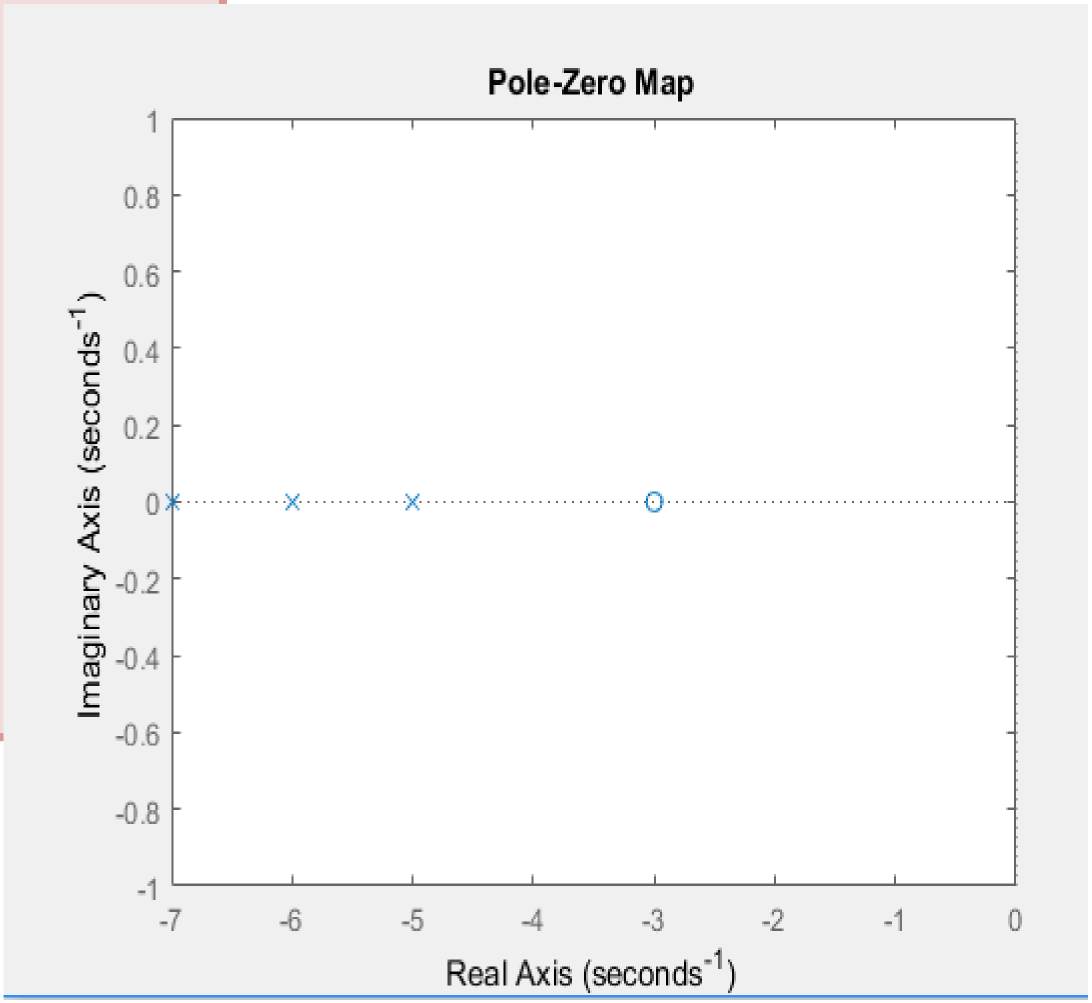
Command Window

New to MATLAB? See resources for Getting Started.

New MATLAB Graphics Syste
MATLAB R2014b introduces a new M
many new features. Some existing c
Learn more

```
>> pay=[8 24];
>> payda=[1 18 107 210];
>> sys=tf(pay,payda)

sys =

          8 s + 24
  --------------------------
  s^3 + 18 s^2 + 107 s + 210

Continuous-time transfer function.

>> zero(sys)

ans =

    -3

>> pole(sys)

ans =

   -7.0000
   -6.0000
   -5.0000
```

```
>> pay=[8 24];
>> payda=[1 18 107 210];
>> sys=tf(pay,payda)
sys =
        8 s + 24
  --------------------------
  s^3 + 18 s^2 + 107 s + 210
Continuous-time transfer function.
>> pzmap(sys)
```



Yukarıdaki karmaşık sayı düzleminde tüm kutuplar (x) negatif yarı düzlemde olduğundan sistem kararlıdır.